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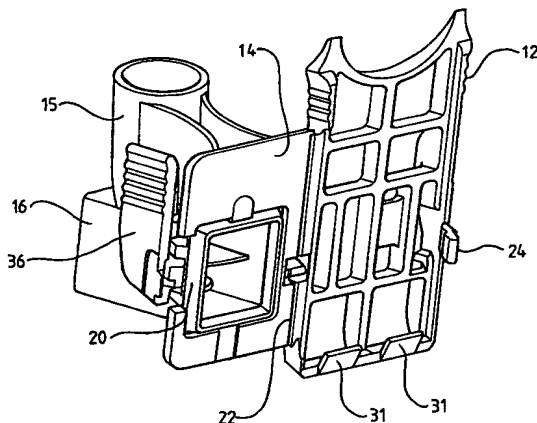
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ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
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(54) Title: CENTRIFUGATION DEVICE



(57) Abstract: A centrifugation device comprising a combined sample chamber and slide holder adapted to be mounted, with a microscope slide (26), in a centrifuge in a predetermined position, after placing a fluid biological sample containing cells in the sample chamber. The device comprises an integrally moulded body (10) affording a base (14) which engages the microscope slide, and also affording a back plate (16) connected with the base plate by an integral hinge (22) a latch mechanism formed integrally with the remainder of the device is arranged, when the back plate (16) is closed against the rear of a microscope slide (26) engaged with the base (14), to locate the slide between the base and the back plate and to hold the back plate in this closed position until fracture of a retaining element from the integrally moulded body. Thus, the device can be used once only. The base includes an aperture communicating with the sample chamber and carries an elastomeric gasket (26) for sealing the edges of the aperture with respect to the surface of the microscope slide. The material of the gasket (20) includes an oil component which, in use, forms an oil film on the microscope slide where the gasket contacts the slide, which can act as a barrier to aqueous fluid and prevents migration of such fluid past the region of the slide contacted by the gasket.

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“CENTRIFUGATION DEVICE”

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THIS INVENTION relates to a centrifugation device comprising a combined sample chamber and slide holder adapted to be mounted, with a microscope slide, in a centrifuge in a predetermined position, after placing, in
10 the sample chamber, a fluid biological sample containing cells, the device being so-arranged that when the centrifuge is operated, a thin layer - ideally a monolayer - of cells is deposited from the fluid onto a predetermined deposition area on the glass microscope slide. Such a centrifugation device is herein
15 referred to as being “of the kind specified”.

Various forms of centrifugation device of the kind specified have been known in the past. Examples of such devices are disclosed, for example, in US Patents 4,391,710; 4,696,743; 4,853,188 and 4,874,582 and European Patents
20 Nos. 0184374 and 0047840. Some examples have been reusable, that is to say it was possible and intended that after the device had been used to deposit cells from a fluid sample onto a first microscope slide, and the slide removed, the device could be cleaned, a fresh slide fitted, a fresh fluid sample placed in the sample chamber and the device again placed into the centrifuge and so on
25 indefinitely. In these arrangements the slide is, of course retained by a releasable and re-attachable clip of some description. Some later centrifugation devices of the kind specified were of the single-use type, that is to say they were designed in such a way that they could not, or could not conveniently, be used more than once, thereby avoiding contamination problems resulting from

improper cleaning procedures between uses. In view of their inevitably disposable nature, devices of the latter character have generally been largely of plastics in order to minimise production costs.

5 It is an object of the present invention to provide an improved centrifugation device of the single use type.

According to one aspect of the present invention there is provided a centrifugation device as herein defined comprising an integrally moulded body
10 affording a base adapted for engagement with a microscope slide, structure on one side of the base defining a chamber for a fluid sample, with an opening for the introduction of fluid to said chamber, the base including an aperture and carrying a means for sealing the edges of such aperture with respect to the surface of a microscope slide placed across the base, or for allowing the
15 passage of liquid but obstructing the passage of cells, the centrifugation device further including a back plate connected with the base plate by an integral hinge and a latch mechanism formed integrally with the remainder of the device and arranged, when the back plate is closed against the rear of a microscope slide engaged with the base, to locate the slide between the base and the cover plate
20 and to hold the cover plate in this closed position until fracture of a retaining element from the integrally moulded body.

The catch arrangement preferably comprises a detent carried by the back plate adjacent the free edge of the latter and which, in operation, co-operates, in
25 the closed position of the device, with a complementary latch carried by the body of the device and connected with said body by an integral live hinge, the catch arrangement further comprising a shield element which, in the condition of the device before use, is secured in a position in which it extends over the complementary latch at a predetermined distance from the integral live hinge of

the said complementary latch, the arrangement being such that in the closed position, with the shield element still attached, the detent on the back plate is retained between the shield element and the complementary latch and the shield element counteracts a turning moment applied to the complementary latch as a result of tension in the back plate detent, whilst on breaking of a frangible retaining element holding the shield member in position relative to the device body, the shield element is able to move away from said complementary latch allowing the latter to swing away from the back plate detent for release of the back plate detent to allow the back plate to swing away from the body of the device, and to allow removal of the microscope slide.

The complementary latch may be provided with a retaining arm which engages a face of the detent on the back plate to push the detent across the abutment face of the latch as the latch tilts outwardly and backwards during the release of the detent after rupture of the connection of the shield member with the body part, and thus to ensure release of the detent from the latch.

An embodiment of the invention is described below by way of example with reference to the accompanying drawings in which:

20

Figure 1 is a perspective view, from the rear and above, of a centrifugation device in accordance with the invention in the condition in which a back plate is closed against a body part with a microscope slide located therebetween;

25 Figure 2 is a view in vertical section through the device and microscope slide of Figure 1;

Figure 3 is a perspective view corresponding to Figure 1 but showing the device with the back plate in an open position in relation to the body part, without the microscope slide;

Figure 4 is a perspective view corresponding to Figure 3 but from the front and below;

Figure 5 is a perspective view from the rear and below of the device with the back plate in an open position with respect to the body part of the device;

Figure 6 is a partial view in horizontal section, and to an enlarged scale, through the device of Figures 1 to 4, along the line VI - VI in Figure 1 showing details of the catch arrangement, in the closed condition of the back plate,

Figure 7 is a corresponding partial section of view in the open condition of the back plate and

Figure 8 is a fragmentary rear elevation view, also to an enlarged scale, of the body part of the device showing the parts of the catch arrangement carried thereby.

Referring to Figures 1 to 4, a centrifugation device in accordance with the present invention comprises a body part 10 and a back plate 12 formed integrally with one another by moulding in a suitable plastics material such as polypropylene, the back plate 12 being connected with the body part 10 by way of an integral "living hinge" 22. As shown in Figures 3 to 5, the body part 10 comprises a generally planar base or flange 14 which carries on its front side integral structure providing a sample chamber 16 which is closed at its end remote from the base 14 and which terminates, in the plane of the base 14, in a port 18 which, in the preferred embodiment, is rectangular. A funnel 15 extends upwardly from an entrance opening in the sample chamber, whereby a fluid sample can be introduced into the sample chamber 16. As shown in Figures 2 and 3, a resilient gasket, for example of an injection mouldable elastomer, referenced 20 in Figures 2 and 3 is carried by the base 14. The gasket 20 extends around the port 18 and protrudes slightly rearwardly from the rear face of the base 14, for sealing against the adjacent surface of glass

microscope slide (26, Figure 2). The material of the gasket 20 is preferably a thermoplastic elastomer such as Evoprene G936, and is moulded in situ on the backplate, the body 10 and integral backplate 12 and the gasket being formed by a two shot injection moulding technique, with the body 10 and backplate
5 being formed in one shot and the gasket being formed in the other shot. The gasket incorporates an oil component which, in use, forms a thin oil film on the slide 26 where the gasket contacts the slide. This film acts as a barrier to the aqueous fluid of the biological sample and tends to prevent migration of such fluid, from the cell layer deposited on the slide, beyond the boundary defined by
10 the region of contact of the gasket, after opening of the centrifugation device and removal of the side. Subsequent processing of the slide and sample layer generally involves immersion of the slide in an alcohol based medium which also removes the thin oil film.

15 The base 14 is generally rectangular, as is the back plate 12, and the living hinge 22 extends along one vertical edge of the base 14 and the adjacent vertical edge of the back plate 12. The vertical edge of the back plate 12 remote from the living hinge 22 carries a detent 24 for co-operating with elements carried by the body 10 adjacent the edge of the base 14 remote from
20 the living hinge 22 and which elements, together with detent 24, form a catch arrangement whereby the back plate may be secured in a closed position on the base 14 with a microscope slide, indicated at 26 in Figures 1 and 2, held between the base 14 and the back plate 12. As illustrated in Figures 1 to 5, the upper edge of the back plate 12 may be scalloped or recessed, as indicated, to
25 allow ready grasping of the upper edge of the microscope slide 26 between finger and thumb during removal of the slide from the device after centrifugation, as described below.

In use of the device, a microscope slide is located between the back plate 12 and the base 14. (Figures 3 and 5 show integral hooks 31 to support the lower end of a microscope slide 26 fitted against the front surface of the back plate 12 until the back plate 12, with the slide, is closed against the base 14). In this condition, as illustrated in Figure 2, the gasket 20 engages the adjacent surface of the slide 26 in a sealing-tight manner.

The device is then mounted in a centrifuge (not shown) in such a manner that bosses 30 projecting from the sides of the back plate act as journals received in bearings provided by complementary slots in mounting structure within the centrifuge. When the centrifuge is at rest, the device rests in the centrifuge in a position in which the slide 26 is at an angle. when the centrifuge is spun up, the device pivots about the axis of bosses 30, into a position in which the slide is vertical. When the centrifuge is spun, the centrifugal force generated produces a rapid settling of the cells within the biological sample against the surface of the glass slide 26, within an area bounded by gasket 20 and these cells remain in a thin layer on the slide after the centrifuge is stopped. In order to ensure a more even distribution of cells across the exposed area of the slide during the centrifuging step, the sample chamber has a plurality of parallel baffle plates 17 extending alternately from opposite sides of the sample chamber, part-way across the latter and generally parallel with the bottom wall of the sample chamber. After the centrifuge is stopped, the centrifugation device removed from the centrifuge, and the slide carefully removed after opening of the back plate as described below.

Referring to Figures 6, 7 and 8, the fragmentary horizontal section views of Figure 6 and Figure 7 show a portion of the back plate 12 adjacent the edge carrying the detent 24 and show the adjacent portion of the body 10 and a latch 32 which is connected with the remainder of the body 10 by an integral live hinge 34. The detent 24 comprises a head portion connected with the adjacent

edge of the backplate 12 by a relatively flexible arm 33. The body 10 also carries an integrally formed shield element 36 in the form of a generally flat plate which is disposed at a predetermined distance from the adjoining side wall of the body 10 and extends over the latch 32. There is thus defined between the latch 32 and the shield element 36 a narrow space through which the detent 24 is projected in the closed condition of the back plate shown as Figure 6. In this position, an abutment surface of the detent 24, facing away from the free end or nose of the detent 24 engages an opposing abutment face of the latch element 32 and, additionally, the surface of the nose of the detent facing away from the shield element 36 is engaged by an opposing surface of the latch 32, afforded by an extension 32A. When the back plate is moved from the open position shown in Figure 7 to the closed position shown in Figure 6, the natural resilience of the living hinge 34 causes the latch 32, originally deflected downwards by the nose of the detent 24, to spring back again into the locking position shown in Figure 6. In this closed position, deflection of the detent 24 away from the part of the body 10 to which the hinge 34 is attached, being deflection such as would allow disengagement of the detent 24 from the latch 32, is prevented by engagement of the detent 24 with the shield element 36.

As a result of the arrangement described, it is not possible to open the back plate 12 without removal or displacement of the shield element 36 which, as described below, necessarily involves rupture of a connecting element. As indicated in Figure 8, the shield element 36 conveniently takes the form of a lever having a free end 36A and pivotally connected with a projection 37 from the body 10 by way of an integral living hinge 40. The end of the lever 36 remote from free end 36A is secured by a narrow and hence weakened connection 42 to the side of body 10. When it is desired to release the back plate 12 for removal of the slide 26, the free end 36A of the shield element 36 is pressed manually towards the adjacent surface of the body part 10 causing

the opposite end of the lever 36 to break from its connection 42 with the body part 10, allowing the portion of the element 36 overlying the detent 24 to move away from the latter allowing the latch 32 to swing backwards and away from the adjoining side wall of the body 10, with corresponding flexure of the arm 5 33 of the detent away from said side part. The leg 32A, engaging the opposing surface of the detent 24, has the function of forcing detent 24 upwards (as viewed in Figure 6) as the latch 32 swings backwards, thereby to assist in disengaging the abutment face of the detent 24 from the opposing abutment face of the latch 32. Of course, after fracture of the connection 42 in the 10 manner described, the latch arrangement described cannot be used to hold the back plate 12 in a fully closed position relative to the body part, thus ensuring that the centrifugation device is a single use device.

CLAIMS

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1. A centrifugation device comprising a combined sample chamber and slide holder adapted to be mounted, with a microscope slide, in a centrifuge in a predetermined position, after placing, in the sample chamber, a fluid biological sample containing cells, the centrifugation device comprising an integrally moulded body affording a base adapted for engagement with a microscope slide, structure on one side of the base defining a chamber for a fluid sample, with an opening for the introduction of fluid to said chamber, the base including an aperture and carrying a means for sealing the edges of such aperture with respect to the surface of a microscope slide placed across the base, or for allowing the passage of liquid but obstructing the passage of cells, the centrifugation device further including a back plate connected with the base plate by an integral hinge and a latch mechanism formed integrally with the remainder of the device and arranged, when the back plate is closed against the rear of a microscope slide engaged with the base, to locate the slide between the base and the cover plate and to hold the cover plate in this closed position until fracture of a retaining element from the integrally moulded body.

2. A centrifugation device according to Claim 1 wherein the catch arrangement comprises a back plate detent carried by the back plate adjacent the free edge of the latter and which, in operation, co-operates, in the closed position of the device, with a complementary latch carried by the body of the device and connected with said body by an integral live hinge, the catch arrangement further comprising a shield element which, in the condition of the

device before use, is secured in a position in which it extends over the complementary latch at a predetermined distance from the integral live hinge of the said complementary latch, the arrangement being such that in the closed position, with the shield element still attached, the back plate detent is retained
5 between the shield element and the complementary latch and the shield element counteracts a turning moment applied to the complementary latch as a result of tension in the said back plate detent, whilst on breaking of a frangible retaining element holding the shield member in position relative to the device body, the shield element is able to move away from said complementary latch allowing
10 the latter to swing away from the back plate detent for release of the back plate detent to allow the back plate to swing away from the body of the device, and to allow removal of the microscope slide.

3. A centrifugation device according to Claim 2, wherein said
15 complementary latch is provided with a retaining arm which engages a face of said back plate detent to push the detent across the abutment face of the latch as the latch tilts outwardly and backwards during the release of the detent after rupture of the connection of the shield member with the body part, and thus to ensure release of the back plate detent from the latch.

20

4. A centrifugation device according to Claim 1, wherein said shield element is in the form of a lever which is pivotally connected with said body of the centrifugation device for pivoting about an axis generally perpendicular to the pivotal axis of the back plate with respect to said body defined by said
25 integral hinge and generally perpendicular to the direction of movement of said detent as it moves into engagement with said complementary latch, and wherein said frangible retaining element normally holds said lever against pivoting but, once fractured, allows said lever to pivot about its pivotal axis to move the part of said lever adjacent said latch away from said latch.

5. A centrifugation device according to Claim 4, wherein the pivotal connection of said lever with said body is also provided by a living integral hinge.

5

6. A centrifugation device according to Claim 4 or Claim 5, wherein said pivotal connection is intermediate opposite ends of said lever, said frangible connection is at one of said ends of said lever and said latch is located between said frangible connection and said pivotal connection, and wherein the other of said end of said lever is free, whereby said frangible connection can be broken by pressing said other of said two ends of said lever towards said body portion, to swing said one end and the region of the lever between said one end and said pivotal connection, away from said latch.

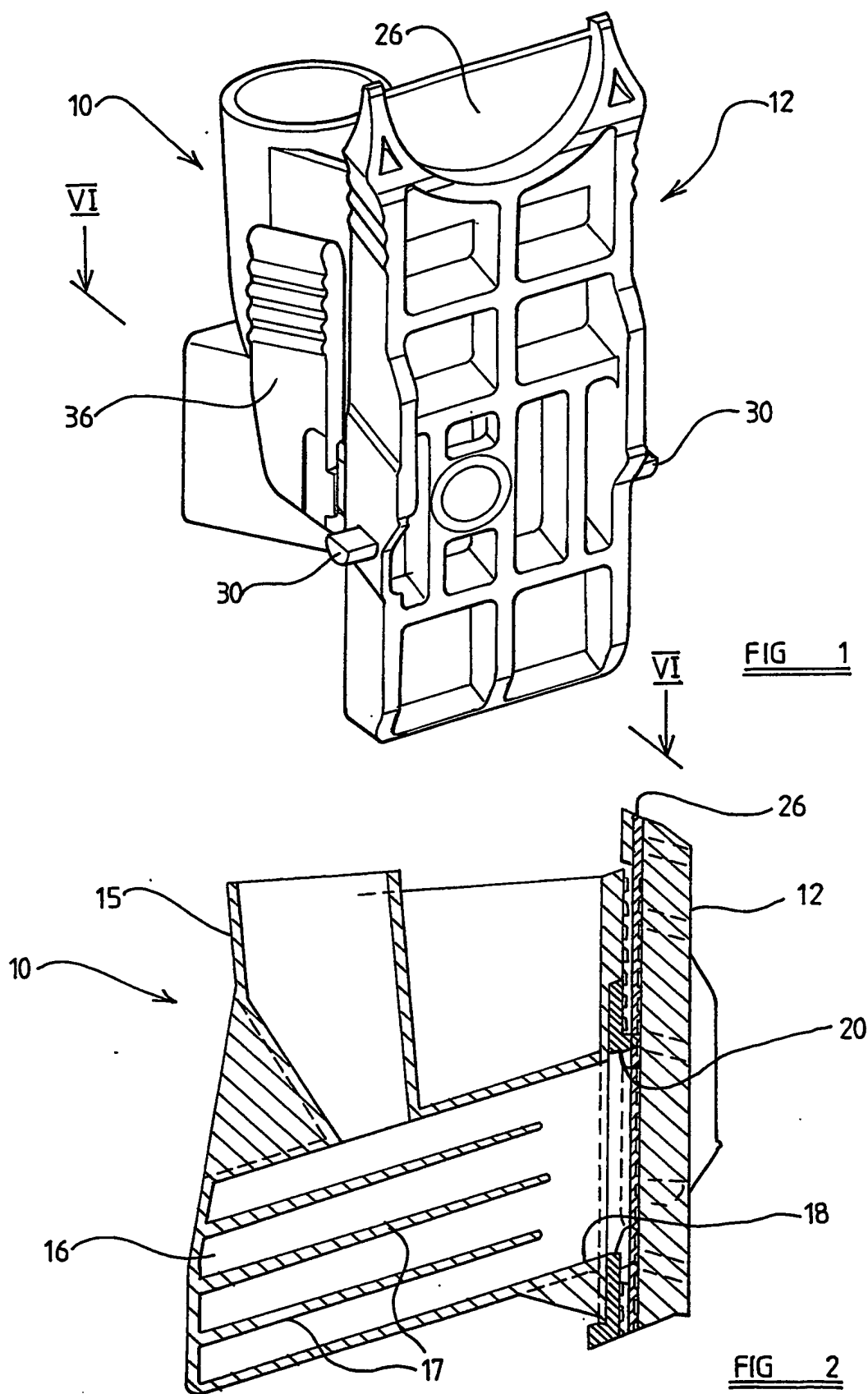
15 7. A centrifugation device comprising a combined sample chamber and slide holder adapted to be mounted, with a microscope slide, in a centrifuge in a predetermined position, after placing, in the sample chamber, a fluid biological sample containing cells, the centrifugation device comprising an integrally moulded body affording a base adapted for engagement with a microscope slide, structure on one side of the base defining a chamber for a fluid sample, with an opening for the introduction of fluid to said chamber, the base including an aperture and carrying a means for sealing the edges of such aperture with respect to the surface of a microscope slide placed across the base, or for allowing the passage of liquid but obstructing the passage of cells, 20 the centrifugation device further including a back plate connected with the base plate by an integral hinge and a latch mechanism formed integrally with the remainder of the device, wherein said means for sealing the edges of said aperture comprises an elastomeric gasket (20) carried by said base (14) and 25

encircling said aperture (18), for engagement with such microscope slide (26) placed across said base.

8. A centrifugation device according to Claim 7, wherein said elastomer is an injection moulded elastomer and is moulded in situ with said body in a two-shot moulding process in which said body and back plate are formed in one moulding shot and the gasket is formed in the other moulding shot.

9. A centrifugation device according to Claim 7 or Claim 8 in which the material of said gasket includes an oil component which, in use, forms an oil film on the microscope slide where the gasket contacts the slide, which soon act as a barrier to aqueous fluid and thus tends to prevent migration of such fluid past the region of the slides contacted by the gasket, after opening of the centrifugation device and removal of the slide.

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2 / 6

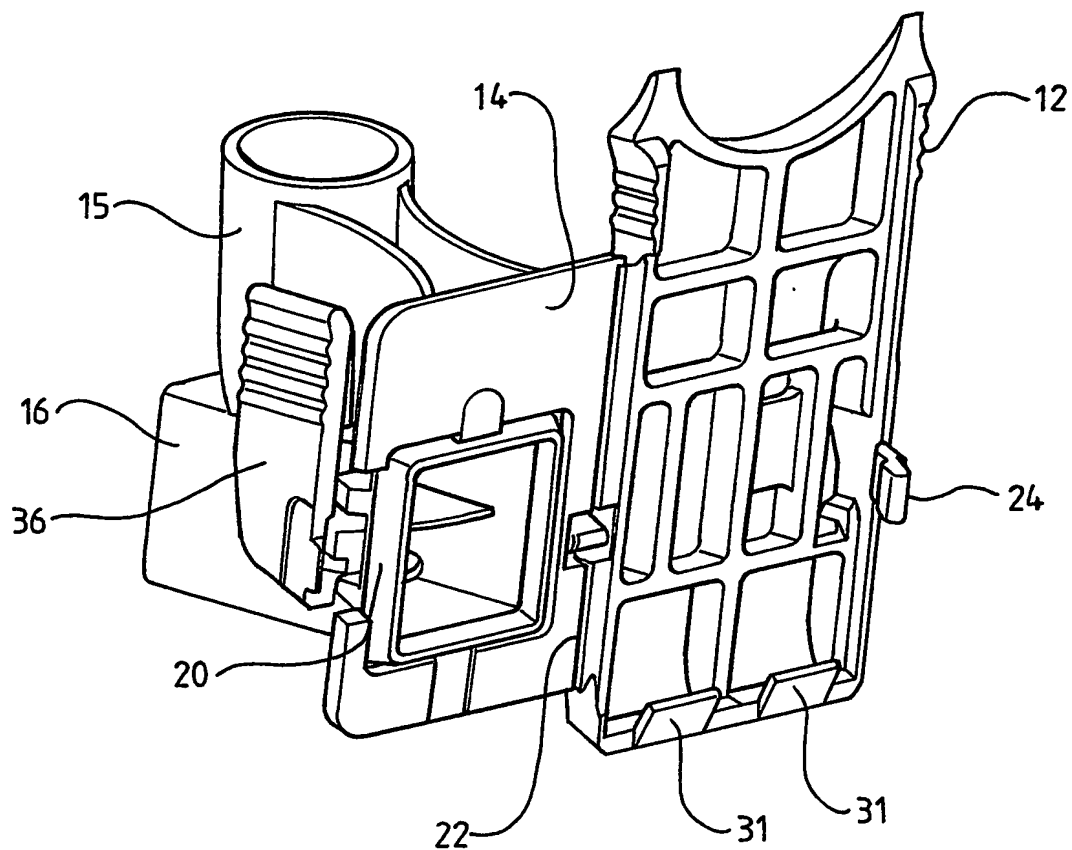


FIG 3

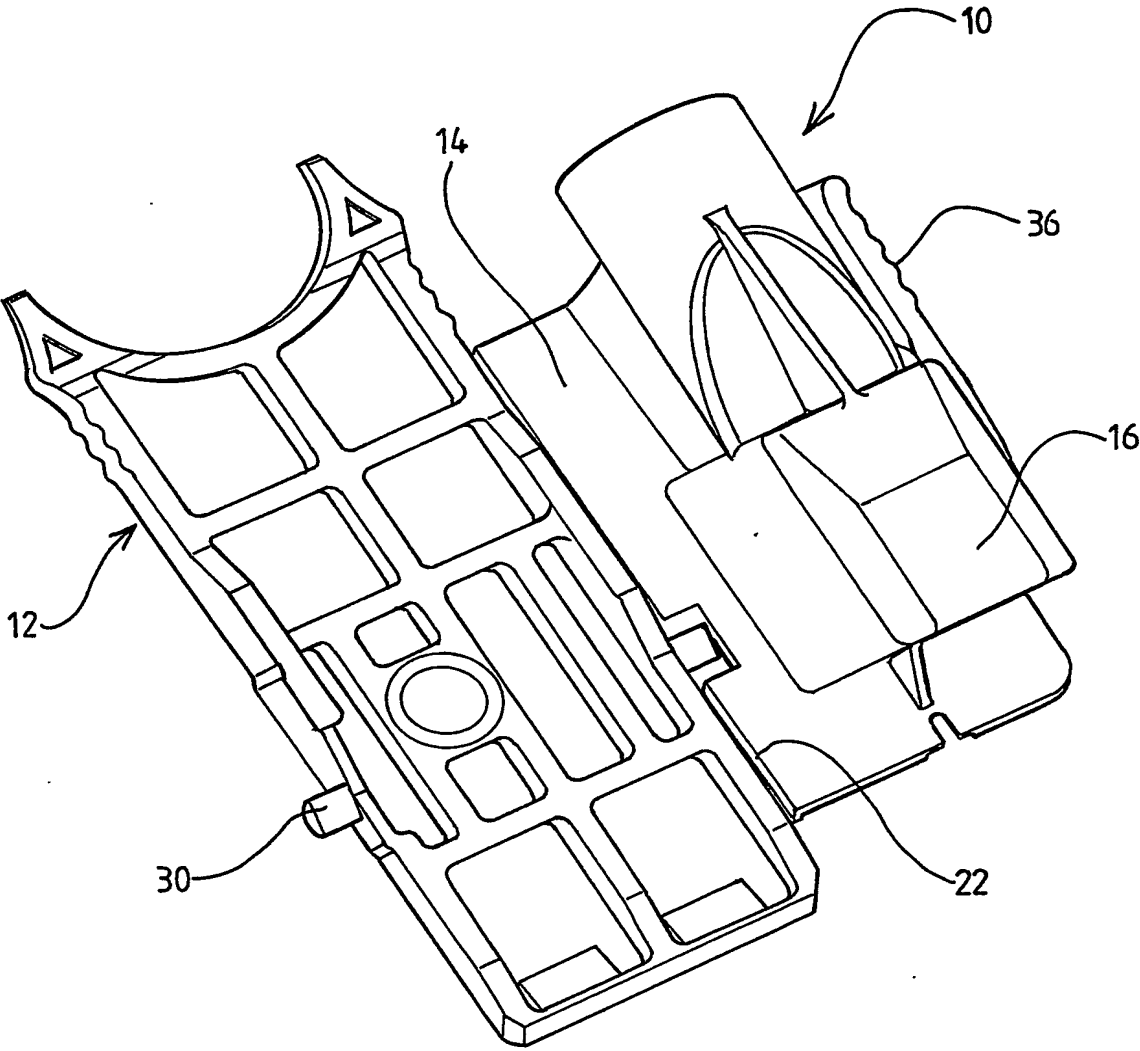


FIG 4

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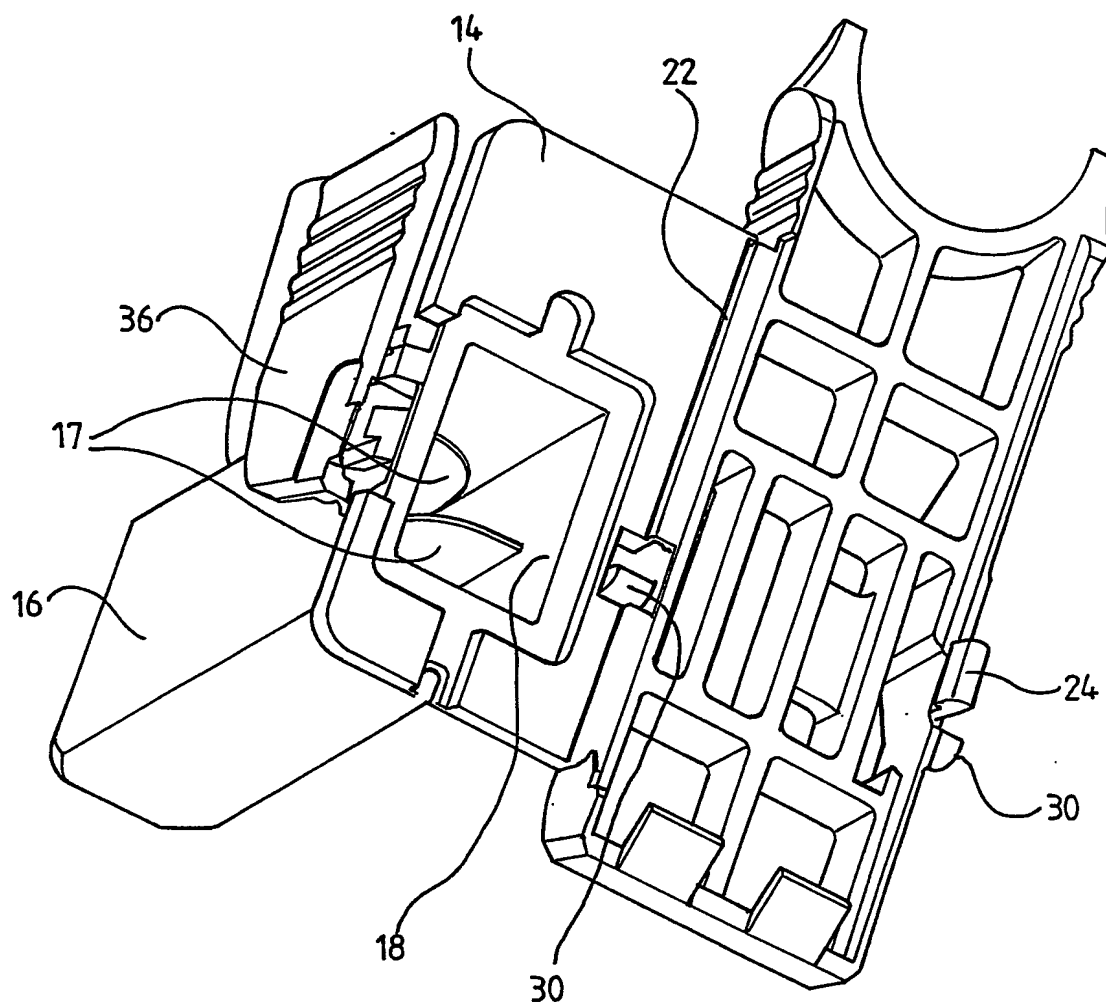


FIG 5

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FIG 6

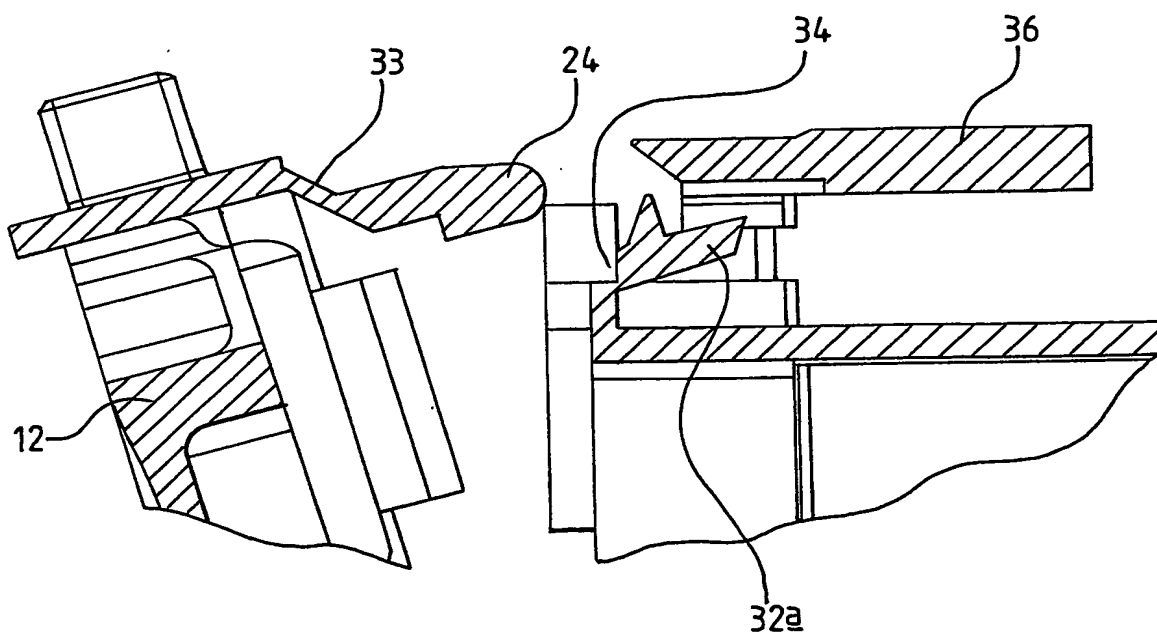
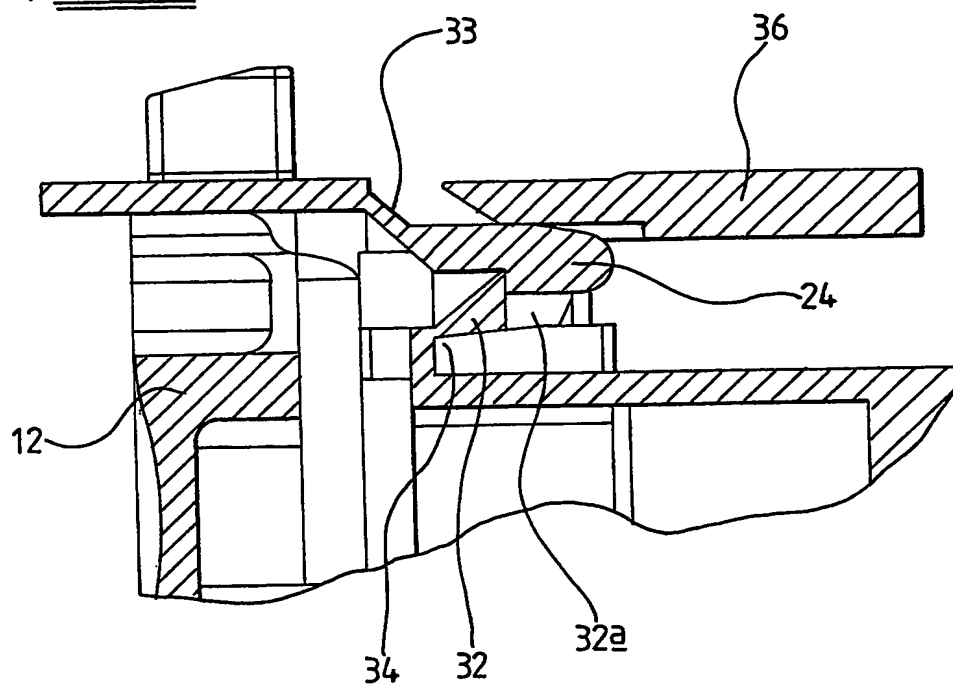
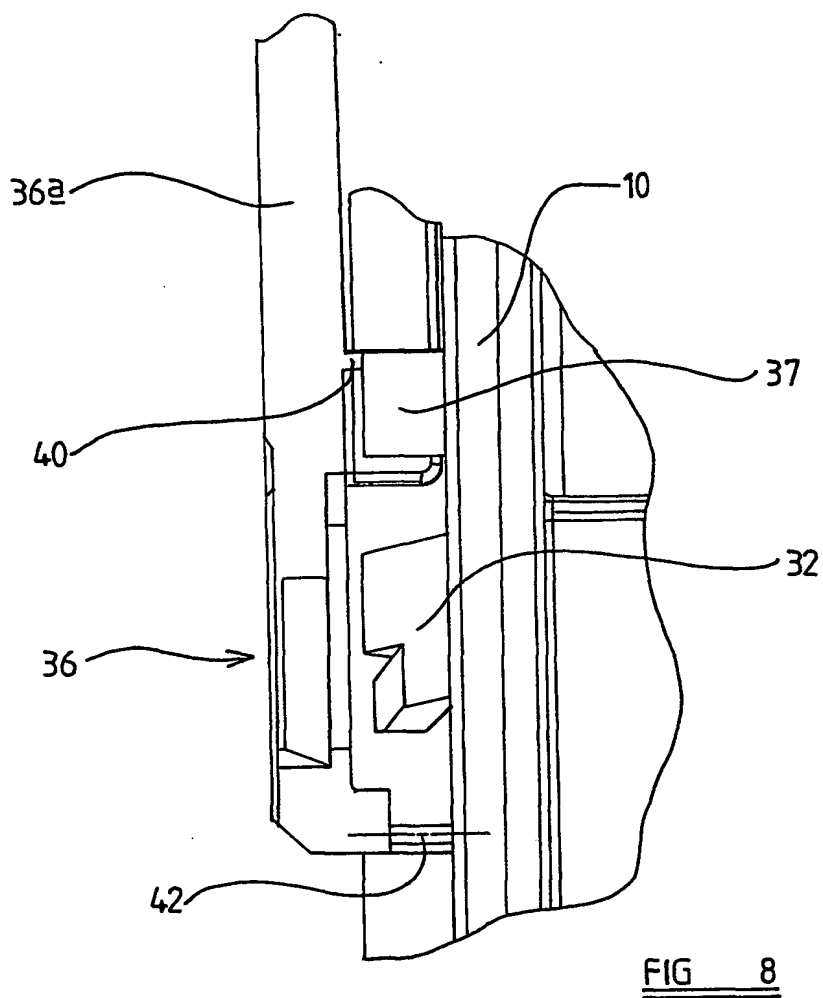


FIG 7

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INTERNATIONAL SEARCH REPORT

Internat. Application No

PCT/GB 03/03524

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N1/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 696 743 A (BILLINGTON DONALD G ET AL) 29 September 1987 (1987-09-29) cited in the application abstract; figures 3,4 column 5, line 37 -column 5, line 54	1,7
Y	US 6 162 401 A (CALLAGHAN KARL J) 19 December 2000 (2000-12-19) abstract; figures 1-3,5 column 3, line 36 -column 3, line 48 column 4, line 20 -column 4, line 37	1,7
A	US 4 874 582 A (BILLINGTON DONALD G ET AL) 17 October 1989 (1989-10-17) cited in the application abstract; figures 1-5 column 4, line 58 -column 5, line 33 -/-	1-9

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search

18 March 2004

Date of mailing of the international search report

31/03/2004

Name and mailing address of the ISA

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Authorized officer

Runser, C

INTERNATIONAL SEARCH REPORT

Interna Application No
PCT/GB 03/03524

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4 853 188 A (TOYA MATSUMI) 1 August 1989 (1989-08-01) cited in the application abstract; figure 8 column 1, line 55 -column 2, line 3 column 4, line 29 -column 4, line 44 -----	1-9
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A	EP 0 184 374 A (WHALE SCIENTIFIC INC) 11 June 1986 (1986-06-11) abstract; figure 2 page 5, line 30 -page 6, line 11 -----	1-9
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INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB 03 03524

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-6

Centrifugation device characterised by a fracturable retaining element to prevent reuse of the device

2. Claims: 7-9

Centrifugation device characterised by an elastomeric gasket as a sealing mean

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 03/03524

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this International application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internat Application No

PCT/GB 03/03524

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